DOCUMENT RESUME

ED 091 195 SE 017 751

AUTHOR	Vannan, Donald A., Ed.
TITLE	Pennsylvania Clearinghouse on Methodology in Elementary Science, Vol. 5, No. 1. A Publication for the Methods Instructors in Higher Education.
INSTITUTION	Bloomsburg State Coll., Pa.
PUB DATE	Apr 74
NOTE	54p.; Printed annually
EDRS PRICE	MF-$0.75 HC-$3.15 PLUS POSTAGE
DESCRIPTORS	Curriculum Planning; *Elementary School Science; Elementary School Teachers; *Methods Courses; Science Education; *Teaching Guides
IDENTIFIERS	Pennsylvania

ABSTRACT

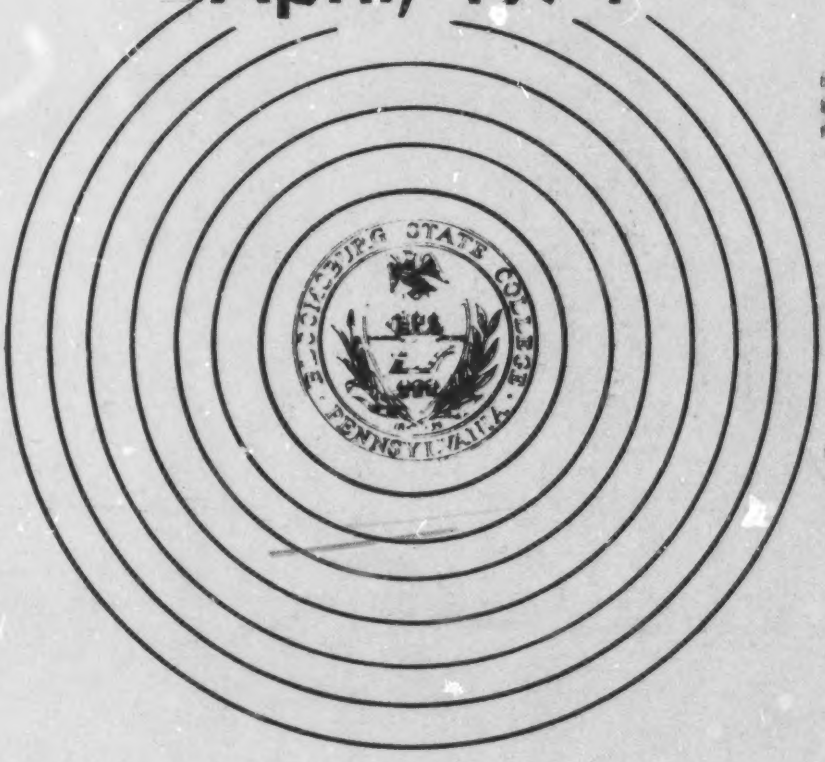
This publication for methods instructors contains articles dealing with science education in elementary schools. Titles of articles appearing in this issue are: The Un[illegible] Box Approach, Let's Take Science Out of the Mouths of the Teacher and Put It into the Hands of the Child, Environmental Education and the Inservice Teacher, A Comparison of Two Methods of Preparing Prospective Elementary Teachers to Teach Science, Pupil Achievement in "Science--A Process Approach," Science Activities and the Retarded Child, The Impact of Selected Nationally Recognized Science Curriculum Projects on Programs to Prepare Prospective Elementary Teachers to Teach Science, [illegible]reservice Science Education in a Four-State Area, Individually Paced Science Education: A Humanistic Approach, and Elementary School Science Instruction in Pennsylvania (Questions and Answers). (DT)

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

ED 091195

Pennsylvania Clearinghouse On Methodology In Elementary Science

April, 1974



Vol. 5 No.1

SE 017 151

ED 091195

THE PENNSYLVANIA CLEARINGHOUSE

ON METHODOLOGY IN ELEMENTARY SCIENCE

A Publication For

The Methods Instructors In Higher Education

Edited by

Donald A. Vannan, Ed.D.

April, 1974

Annually

Edited, printed, and bound at Bloomsburg State College,
Bloomsburg, Pennsylvania, as a service to all educators

EDITOR'S MESSAGE

Greetings to all of you involved in elementary science education in institutions of higher education!

If you're an old reader of The Clearinghouse, (we're five years old today, or rather, this year), welcome back to the latest edition. If you're a new reader this year, we're an annual publication for science educators, first copy is free (just for postage of $ .24) and additional copies $1.00 with check made payable to the Bloomsburg State College Trust Fund # 477T. We hope that you will find something of interest in your academic area in some of the pages. Note, please--no advertising! Isn't it a pleasure in this day and age?

Old readers will note a change in format to single-spaced layout, as opposed to the double-spaced previous editions. This is to save space, conserve paper, and be more conservation conscious in general. Also, the Department of Education in Harrisburg was unable to furnish us with funds for this edition, so we're flying on a low, low budget. Also, a limited number of copies will have the standard cover and binder, but at least one-half of the editions will get plain white covers with a trio of staples to hold the pages together. Sorry, but it's better than suspending the operation altogether.

Well, what's new for this year? I am a bit excited about a capsule shorthand (yes, shorthand) course I induce into my methods course each semester now that I've returned from my sabbatical to England. With all of the record-keeping I saw of children's achievements in the elementary (infant and junior) schools I visited, I realized that the American teacher would have to have shorthand skills to do the same thing that the English teachers are doing so well. Incredible amounts of excellent data are written up each day on each child--much more than we do in our schools. The techniques were to have the children come to the teacher, recite or show their work, have it checked, and also have it recorded in half symbol-half word or phrase inscriptions in a loose-leaf notebook. At the end of the day, or when time permitted, the same record (described above) was used to write up a very detailed accounting of what each child did in each of the subjects taught! Well done! Good show!

Now all of you know that I can't have even a mini-course taught in my methods course in its entirety, but I do have the essentials of a method of alphabetic shorthand (using all of the familiar abbreviations, too) taught by cassette tape and simple exercises. Speed is left to be built up after the course has been completed. Check into the various commercial courses available on tape--use the advice of a competent shorthand teacher or instructor in your area. At present I only use it for three hours.

EDITOR'S MESSAGE (cont'd.)

Usually each article in this publication runs approximately 4 single-spaced pages with a summary section at the end (for harried readers). An exception of notable proportions is the Pennsylvania Study dealing with elementary science in elementary schools. It was deemed of such importance that no editing was performed and it is presented in its entirety. Look for it.

The sabbatical to England, which necessitated the cancelling of last year's Clearinghouse, took my wife, daughter (aged 5) and me to London, Bristol, Cheltenham, York, Leicester, Nottingham, and Oxford, with side trips to Wales, Ireland, and Scotland. In each location other than London and the latter countries, we visited elementary (infant and junior) schools for three days each, learning about individualized instruction, open classroom techniques, integrated day, and especially the elementary science program known as "SCIENCE 5/13," (ages 5-13). It was an excellent experience, and has pretty much convinced me that the open classroom (not the open school) is the nearest thing to perfection we can look for in the near future. The excellent teacher in four walls still has my vote, especially with English-type record-keeping techniques. My wife (an elementary teacher, always observed and took notes in classroom other than ones I was in, my daughter always was entered into the Reception Class (youngest), and at night we would all swap notes, ideas, and impressions. Kimmie discovered how to read in England, and it was a thrill to be in the school when it happened.

In Bristol, at the University of Bristol, I had a very enjoyable and informative chat with the director of the "SCIENCE 5/13" program, Dr. Len Ennever. For an hour we chatted about the differences and similarities between American and Bristish approaches, the sponsoring agencies (The Schools Council, The Nuffield Foundation, The Scottish Education Department), and the testing program for the various units of study. Inquiries for sample materials (ex. "Report For Teachers On The Evaluation Of Children And Plastics, Stages 1 and 2 And Background Information") can be directed to Dr. Ennever at the University, 19 Berkeley Square, Bristol, BS8 1HF, England.

With kindest wishes to all of you for a wonderful New Year and a successful and soul-satisfying remainder of the year to you and each of you.

Donald A. Vannan

Donald A. Vannan, Ed.D.
Editor

ACKNOWLEDGEMENTS

The Editor wishes to thank:

(1) the authors, for their manuscripts on science education, without which there would be no need to continue this publication

(2) the college administration, for allowing the publication to go into its fifth year

(3) the student secretaries who do all of the typing and proofing of their work

(4) Mrs. Nellie Edwards and her excellent staff in the Machines Room--duplicating and binding

(5) Dr. Mitchell Batoff and J. of School Science and Mathematics, Indiana U. of Pa., for the excellent article adaptation on Unit Boxes.

(6) Miss Phyllis Marcuccio, Science and Children, for her editorial understanding and cooperation in advertising the publication in the "Ad-Vailables" column free of charge.

(7) you, the reader, for helping to spread the word about what we are doing.

PROSPECTIVE AUTHORS

If you are interested in submitting an article for consideration, the following points will be of interest:

(1) you must be a college instructor teaching a course generally titled "Methods And Materials In Elementary Science" or have a specific connection with science education

(2) the article must deal with a topic applicable to elementary science as it applies to a methods course at the college level

(3) you should use the form at the end of this publication to submit your article for consideration

(4) you will not be paid for the article, but you and your campus library will each receive one free copy; additional copies will cost $1.00 paid in advance with check made out to THE BLOOMSBURG STATE COLLEGE TRUST FUND #477T and sent with your order to the Editor (Zip 17815)

(5) contributors from out of state are always welcome to send in manuscripts for consideration; this issue contains some articles from out of state readers, too

(6) a permanent mailing list is not maintained; if you want a copy each year you must send in an article, or ask for a library loan copy from the Editor

(7) articles usually deal with methods used in the methods course but may include specifics such as college public relations, consultative work, and philosophical viewpoints or operational imperatives

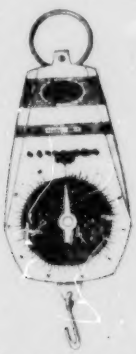


TABLE OF CONTENTS

PAGE

The Unit Box Approach..... 1
Let's Take Science Out Of The Mouths Of The Teacher And Put It Into The Hands Of The Child..... 7
Environmental Education and the In-Service Teacher..... 11
A Comparison of Two Methods of Preparing Prospective Elementary Teachers To Teach Science..... 15
Pupil Achievement In Science--A Process Approach..... 18
Science Activities and the Retarded Child..... 23
The Impact of Selected Nationally Recognized Science Curriculum Projects On Programs To Prepare Prospective Elementary Teachers To Teach Science..... 26
Pre-Service Science Education In A Four-State Area..... 31
Individually Paced Science Education: A Humanistic Approach..... 34
SPECIAL!
Elementary School Science Instruction in Pennsylvania (Questions and Answers)..... 38

Author Manuscript Submission Form (including information on ordering additional copies)

The Unit Box Approach:
A Novel Facet of Elementary School Science Teacher Preparation[1]

by

Mitchell E. Batoff

The Unit Box is a seminal development in elementary school teacher preparation. Its construction is the principal assignment in a science methods course evolved by the author over a five year period at Jersey City State College.

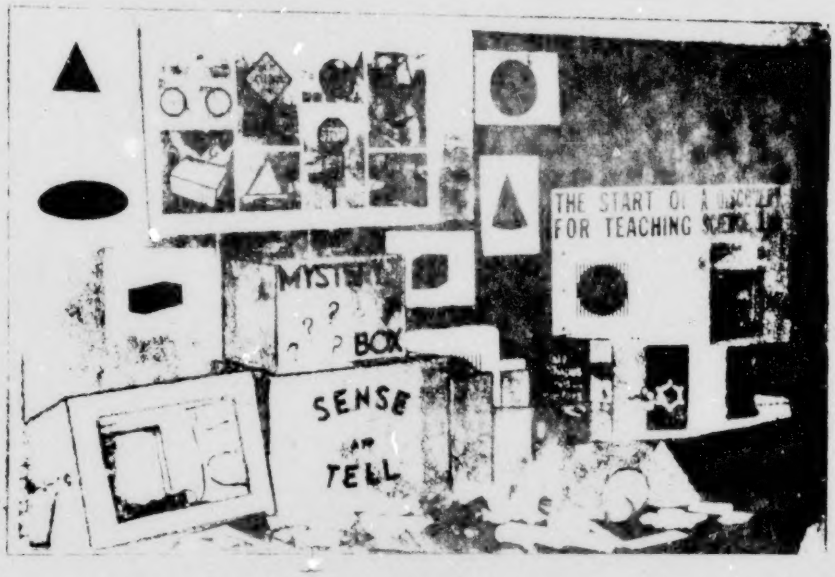
Each student in the course assembles an inquiry-oriented, materials-centered, multimedia unit package. Its core is a commercially-available unit of study that has been tested in many classrooms. Units of a modular nature are used and they may be teaching units, resource units, or quasi-resource units. Students put their boxes together outside of class in the five-or six-week period preceding their student teaching and use them during their teaching assignment. Where the methods course is taught in the schools, Unit Box preparation is concurrent with the fifteen week apprentice teaching. In either case, the Unit Box enables students to do with children the kinds of teaching-learning they joyfully experienced in their methods course; with materials at hand an ideal can become a reality not a pious wish.

---

[1]The term "Unit Box" was coined by the author in January of 1969.

Dr. Batoff is Associate Professor of Science Education at Jersey City State College

BEST COPY AVAILABLE



Unit Box Display Exhibit - end of course

Student with his Unit Box

The Unit Box is a novel approach and in the author's course at Jersey City State College it has replaced the writing of science units--a widespread practice for which elementary education students generally are ill prepared.[2] The thrust of this approach is the implementation of the unit around which the box is built. Students are asked to start with a good modular teacher's guide and to bring together all the hardware--in multiples, all the supportive software, and all the other media needed to teach the unit effectively. Great emphasis is placed on getting and making appropriate manipulative materials in classroom quantities of thirty-two or sixteen. But the focus of the approach is on learning rather than teaching and the Unit Box helps to provide a stimulating learning environment.

Each Unit Box is not only a multimedia, but also a multisensory, and multilevel package of instructional materials and strategies intended for in-depth use over a period of four to eight weeks or longer. Each one is custom made by the apprentice teacher and he owns and uses it. Its purpose is to actively involve children and teachers in investigations associated with a unit of study chosen from the geophysical or biological sciences and, in the process, to assist in developing the skills of observation, classification, measurement, sampling, extrapolation, communication, number use, inference, and the like. Some topics and teacher's guides also facilitate the deveopment of motor skills.

A Unit Box consists of the following integrated components:

1. One or more related teacher's guides used as a starting point.
2. Manipulative materials for each pupil
3. A set of record sheets or work sheets for pupils
4. A tape cassette, associated work sheets, and manipulative materials[3]
5. A set of overhead transparencies
6. Trade or library books for pupils and teacher
7. A set of vocabulary cards
8. A construction project to provide enrichment
9. Thoughtfully considered evaluation devices
10. A large sturdy box, smaller containers, and a file--all labeled and organized.

The boxes may contain a wide variety of other instructional materials--large pictures, charts, science learning games, slides, task cards, information on field or museum trips appropriate to the unit, and a teacher-made filmstrip. Manipulative-investigative materials are the essential part of the Unit Box but a few demonstration articles may be included singly or in small numbers.

Why provide material in quantity? Scientific investigation involves experiences in search of meaning; teaching that gives excitement and pertinency to learning affords direct exposure to phenomena. For these, materials are needed. The Unit Box Approach seeks to involve each pupil in a search for first-

---

[2]This statement is expanded at considerable length and documented with numerous references in a longer report available from the author. The paper presented here is a much condensed version of the full report in which many reasons are given for <u>not</u> having elementary education students write science units.

[3]This quasi-audio-tutorial component of the Unit Box might be considerably expanded. The writer may at some future date explore the idea of having an entire Unit Box built around a sequence of A-T modules. For more information on this topic consult the work of Novak at Cornell, to be published in 1974 or 1975.

hand evidence by providing concrete materials in a "wet laboratory" situation. This is a mandatory condition for teaching children--a compelling reason for placing emphasis on materials.

Where and how do students obtain all these materials? They are obtained from diverse sources and by various means. Scavenging plays a prominent role in the Unit Box experience. Some devices the students build, others they improvise from recycled objects, and a great many items they have to buy. But a concerted search has produced an over-expanding list of free and low-cost hardware. Each semester it becomes easier and more economically feasible for students to obtain classroom quantities of such items as magnifying lenses, Celsius thermometers, fifty cent cameras, compasses, magnets, and live butterflies. This assignment represents a cooperative rather than competitive venture between college teacher and his students.

What are some of the values of this approach? The emphasis on making and collecting items involves students in using materials and living organisms in inquiry teaching. Students are immediately confronted with the problems of obtaining end rewards of using concrete materials in teaching children. But, as several science educators have suggested, one of the most valuable outcomes may prove to be the experience of producing the kit. The student scrounges, improvises, builds, assembles, shops, orders from catalogs, "debugs", and creates tangible objects; he reads and builds a library of books and pamphlets; programs and uses audio tape cassettes; makes overhead projectuals; previews films and filmstrips, produces films, loops, slides, task cards, vocabulary cards, and learning games; he laminates, designs, organizes manipulative materials and print media of all sorts, visits places, tests hardware, and explores phenomena. In short, he undergoes a very broad and practical learning experience.

How and where does the student begin? He is exposed to a wide variety of modular teacher's guides in the first session of the methods course. At that time, he has a chance to look over more than a hundred units available on campus and to collect printed descriptions of several hundred teacher's guides. After consultation with his cooperating teacher, he selects a unit around which to build his Unit Box. His choice is influenced by his background and inclinations, the science curriculum and/or texts used in the school to which he is assigned, and suggestions his instructor makes on the strength of past experience with the units. Students are urged to choose a topic in which they can become deeply involved and around which they can build an enthusiastic classroom experience. A central purpose of the Unit Box Approach is to have each apprentice teacher acquire a depth of knowledge in a particular area through firsthand experience, and to deveop expertise in exploring and teaching the unit. It is desirable that each student teacher pursue a different topic, since both students and teacher learn more if a wide variety of units is handled by the class.

What are the sources of teacher's guides and resource units for the Unit Boxes? To date, there are four main sources: the Elementary Science Study (ESS); the modular Experience in Science Units(EIS) authored and tested by Tannenbaum and Stillman; the Science Curriculum Improvement Study (SCIS); and the pre-primary Sense and Tell authored and tested by Marshall, Podendorf, Swartz and Shoresman. In addition, a number of successful Unit Boxes have been assembled using Minnesota Mathematics and Science Teaching Project (MINNEMAST) units; Guppies, Bubbles and Vibrating Objects; and Kitchen Photography. These seven sources offer the student teacher 159 choices of units in science and mathematics

and six different formats in teacher's guides. The latter vary in sequencing suggested, in statement of objectives, and in the amount of background information given. Since research has not shown that any one program or type of teacher's guide is generally superior to all others, the apprentice teacher should be given an opportunity to shoose one that he finds personally appealing. A great variety of unit modules are available from sources not listed above but these are, for the most part, less accessible and/or not so well tested in the classroom. Currently under review as additional starting points for Unit Boxes are the following: Science 5/13 from England, BEBCO Guides developed in Maryland; Examining Your Environment (EYE) developed in Ontario; University of Illinois Project in Elementary School Mathematics and Science (UICSM); Individualized Science (IS) modules; Science Inquiry Project Series (quasi-resource units); ASEP modules being developed in Australia; SCOPES units under development at the University of Northern Iowa; units developed for the African Primary Science Program; ESCS units from Newfoundland;[4] and pollution control units developed in a Union, New Jersey project. In addition to being used at Jersey City State College, some of these guides were used in the Unit Box Project conducted for the Ontario Ministry of Education in the summers of 1972 and 1973 at Owen Sound and Ottawa respectively. It should perhaps be noted that Science--A Process Approach, the printed exercises developed by the Commission on Science Education of the American Association for the Advancement of Science, do not seem to lend themselves to the Unit Box Approach. Nevertheless, this matter is still being explored. One possibility, which the writer would like to try, is to have a student put together a Unit Box built around a sequence of S-APA exercises on metric measurement (or utilize the entire series of eighteen exercises on measurement).

Where and how do the students obtain the teacher's guides. Guides for each modular unit are obtained through the college bookstore, from the publishers, and in some cases from the professor. Since the Unit Box was introduced in 1969, the ordering of units through the college bookstore has taken considerable time. A half-yearly inventory of supply is taken and units are reordered each semester. Teacher's guides are ordered in numbers varying from four to forty depending on the title. The Curriculum Materials Center has a full collection of ESS, EIS, SCIS, EYE, BEBCO, UICSM, Science 5/13 and MINNEMAST Teacher's guides and similar sets are on reserve in the college library at Jersey City State College. Thus, in addition to seeing the guides briefly at the first class session, students can examine them in the Curriculum Materials Center or borrow them from the library before making their choice. It is important to get the selection of teacher's guides into students' hands as quickly as possible both for viewing and purchase.

At the conclusion of the methods course on campus or the program in the schools, each student brings in his completed Unit Box and everyone has an opportunity to see all the boxes. Twenty minute conferences allow the professor to discuss with each student the contents and use of the Unit Box. Each box is then photographed so that it may be shown to future classes. Large open-house displays may be set up in the gymnasium or cafeteria to give the boxes more exposure and such displays at Jersey City State College and in Ontario attracted hundreds of viewers. They also engendered a valuable cross-fertilization of ideas among the students involved, their teacher, and outside visitors.

---

[4] During the Spring Semester of 1974 the writer is exploring the use of ESCS Teaching Guides. Students will use ESCS process/principle oriented units (as a nucleus for their Unit Boxes) in combination with the relevant ESS, SCIS, EIS or MINNEMAST Units. ESCS is a second generation hybrid, and like biological hybrids may be even stronger than its pure strain origins. This Canadian curriculum represents a synthesis of some of the most significant elements in AAAS--S-APA and ESS plus elements of SCIS and MINNEMAST

Ideally, the apprentice teachers have an opportunity to use their Unit Boxes and see their efforts come to fruition during the practice teaching experience and hopefully in their own classrooms after graduation. As assessment of what they actually do in science in the classroom is made through classroom visits and is part of a follow-up study of the Unit Box Approach that will be published in 1974-75. To date, the study has included well over six hundred classroom visits and nearly seven hundred interviews.

As of January 1974, 733 Unit Boxes have been assembled over a ten semester period at Jersey City State College. The boxes were prepared by early childhood, general elementary, and special education majors for grade levels pre-kindergarten through grade eight; by day students and evening students; by preservice students and inservice teachers; by undergraduates and graduates. Most of the Unit Boxes centered on topics in the physical and biological sciences (e.g., Batteries and Bulbs, Mystery Powders, Life Cycles, Material Objects, Continuity of Life). Some, however, were interdisciplinary or mathematics oriented units (e.g., Peas and Particles, Relative Position and Motion, Attribute Games and Problems, Time). Students enrolled in the Ontario Ministry of Education Certificate Program in elementary school science produced 104 Unit Boxes in 1972 and 39 boxes in 1973. This was inservice application of the idea.

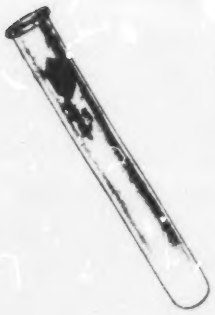
SUMMARY

The Unit Box Approach minimizes certain traditional writing and copying activities frequently encountered in education courses. Instead of finishing the course with the usual paper (unit) the student ends up with a complete custom-made multimedia kit plus a background of many experiences associated with its construction and use.

In summary, the Unit Box is mainly but not merely a collection of <u>things, assembled</u>, <u>used</u>, <u>and owned by the apprentice teacher</u>; it is a teaching-learning mediating system that interlocks materials and other media with the development of concepts, intellectual process skills, pupils' self-image, language facility, and desired attitudes toward school, science, and above all, toward learning. These are its aims. The thrust of the Unit Box Appraoch is development and acquisition of materials and strategies to <u>implement</u> a tested Unit in the classroom; to implement recognized and worthy objectives. It is this rather than curriculum writing or unit writing. Successful implementation of the Unit certainly depends on the teacher's skill in handling the contents and class effectively. Organization and disciplined freedom are key elements in the magical mix of successful utilization. But being prepared with all the materials at hand and experience in their acquisition and use--is surely an important beginning. This is the Unit Box Approach.

Try it!

An earlier version of this paper and the project described herein was honored by the National Science Teachers Association and American Gas Association through a S T A R (Science Teaching Achievement Recognition) Award for 1973.



Let's Take Science Out of the Mouths of the Teacher and Put It Into the Hands of the Child

by

David S. Sarner

The teaching of science in the elementary school is currently undergoing a revolutionary change from the teacher dominated, teacher directed accumulation of facts, to the process centered approach where the child is actively engaged in the process of discovery. Active involvement in daily observations in the urban and suburban public elementary schools as a supervisor of student teachers and as a consultant has revealed that very little science teaching takes place in the average classroom. A great deal of emphasis is being directed to the teaching of reading and mathematics because testing results have indicated a great need for concentration in these vital areas. Most grade teachers readily accept this as an excuse to leave science alone or when they do attempt some science activity, it usually consists of a poorly conducted teacher demonstration or just reading about it in a textbook which is ten years old.

Dr. Sarner is Associate Professor of Education, City College of New York.

Many who are concerned about this failure to teach science in the elementary grades have attempted to rectify the situation. As a result, the past few years have seen a prolification of new curricula for the grades. Most of these are now on the market in kit form and are offered for sale by many commercial firms:

(1) At prices generally far too expensive for the average public school system. Most of the new commercial programs require some in-service training sessions for the teachers who will become involved. A study of six new elementary science curricula conducted by the center for Urban Education from 1966 to 1968 reported that most teachers exposed to special in-service training programs to introduce them to materials soon reverted to their old ways of teaching when left alone.

(2) The above statements are not to give the impression that all teachers fail to teach science in their elementary classrooms. There are a number of excellent programs in progress which are having great success involving the child in science in the elementary grades. The "Open Corridor" programs at selected Harlem schools have reported some very interesting results.

(3) Many school districts in New York City have special programs which involve thousands of grade school youngsters in some phase of science activity.

(4) However, most of these are special out-of-class room programs supported by either state or federal monies and thus exist on a year-to-year basis.

But, special science programs, temporarily supported, are not the answer. Nor do the new "kit" programs offer the solution to the problem of convincing the average elementary school teacher that she can and should teach science not for the sake of science itself but as a tool to motivate the youngster to read and to measure (mathematics).

Science teaching in the grades faces a number of problems foremost among which are:

1. The emphasis is on the teaching of reading and mathematics.

2. The average grade teacher has had very little science training and hence is "afraid" of it.

3. The average school provides very little science equipment and when it does, usually only enough for teacher demonstrations.

4. Most schools seldom provide science coordinators to assist the grade teacher.

5. Most teachers are unaware of the vast store of free science resource materials available to them.

6. There is a need to convince the teacher that she can have her classes make a simple equipment that the children will need in their discovery lessons.

7. The teacher needs to be convinced that a child learns by discovery not by the accumulation of facts.

8. Need for enthusiasm for science - make it seem like fun.

Now that we've enumerated some of the problems facing the teacher who even contemplates teaching science in her class what can be done about it:

1. Even though the administration insists upon heavy concentration on reading and mathematics, the teaching of science through discovery readily lends itself to the need on the child's part to read about and to use mathematics to measure what has happened in his science experience. Instead of just planting a seed in a container and caring for it, the child can report his observations (language arts) and measure weekly growth (mathematics).

2. Elementary classroom teachers need exposure to the process of observation and discovery. More methods classes should be conducted in which the would-be teacher or the in-service teacher is taught how to teach discovery by involving her in actual personal experiences in the process.

3. The methods classes should be concerned with the teaching of construction of simple science equipment which can be used by the children. These should be made of "junk" readily found in the average school or home. Construction of "equipment" can be done under art instruction.

4. School districts must be convinced that properly trained science coordinators should replace the generally untrained science "cluster" teacher who replaces the regular teacher in demonstrations once or twice a week.

5. Methods classes must devote more time to making the teacher aware of the vast supply of free and inexpensive resource material available from industry.

6. Although many teachers have been exposed to and have been willing to try to use the discovery approach in their classrooms, they have been discouraged by the administration who are generally not aware of new curriculum changes. There is a need for in-service courses directed toward the public school administrator with the philosophy, the content and the method for he cannot readily accept a change about which he knows little or nothing.

The discovery approach to teaching science in the elementary grades has been mentioned a number of times in the foregoing. Perhaps a simple example of a lesson might be helpful in clarifying what is meant by "Let's take science out of the mouth of the teacher and put it into the hand of the child."

The popular approach to teaching a lesson on growing seeds would be to soak some lima beans seeds overnight and then the next day in class give each child two pre-soaked seeds. The child is told to look at the lima bean seed and to remove the hard coat to find the seed inside. Next the child is cautioned to carefully open the two halves and, lo and behold, he finds a "baby" lima inside down at one end. Next after "seeing" the baby seed about which the child is told that it becomes a new plant, the child is told to place the second seed in a container of soil which the teacher has provided in a paper cup for each child. After the planting, the cups are watered, names of children written on them and then placed upon the window sill to grow (hopefully). After two or three weeks, during which time the plants have been ignored except when someone recalled the need to water them, the plants are again noted as having grown or died and the child is encouraged to take the plant home to show the parents that science has been a part of the program.

Instead of the above popular approach the teacher could have introduced plants in a number of ways. One example would be to bring in a three week old lima plant growing in a tin can. The can is placed on the table in front of the children and "accidently" knocked over on its side. Instead of becoming concerned that the soil was scattered over the desk, the teacher evinces surprise and raises the question, "I wonder how the plant will grow now that it is on its side? Will it grow up? Down? Or straight out? How can we find out?" The teacher then encourages the children to offer solutions until someone says, "Let's let it grow-then we can find out."

Now they are on the way to discovery-they wait and see, they observe and note. The children can measure the growth every 3 or 4 days and record the results by means of strips of paper glued to a line (bargraph) or be recording the changes in parts of inches.

By simple questions, the teacher can get the class to consider the effects of water, heat, light and food upon plant growth by encouraging the children to consider these variables in the form of simple experiments such as heat vs. cold, light vs. dark, water vs. dry, plant food vs. none. Of course the teacher does not suggest children make these choices but she leads them to the type of action which involves them in finding out for themselves. The teacher must learn to say, "I don't know, how can we find out?" instead of giving the child the answer.

SUMMARY

Because of the proliferation of new expensive commercial science kits and because the average elementary classroom teacher is "afraid" of science, little or no science is being taught in the grades. Methods classes must be redirected toward convincing the teacher that the child must be given the opportunity to become actively engaged in the process of science. The teacher must learn to stop talking about science and permit the child to become involved instead.

ENVIRONMENTAL EDUCATION AND THE IN-SERVICE TEACHER

Thomas C. Moon

It is vital to effectively educate man regarding his relationship to the total environment, the interrelationships between the community and surrounding land, and the opportunities for the individual to be effective in working toward the solution of environmental problems. The new approach called "environmental education" is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to solve these problems, and motivated to work toward problem solution.[1] Serious efforts at developing sequential environmental education curricula for both the elementary and secondary school student are becoming increasingly evident. Such efforts place new demands upon teacher training institutions, and colleges of education throughout the nation are responding to this emphasis by designing unique programs to prepare both pre-service and in-service teachers.[2]

[1]National School Public Relations Association, Environment and the Schools Washington, D.C., 1971, p. 46.

[2]John H. Treat, "Environmental Education," The Science Teacher, No. 39, (October, 1972), 48-49.

Dr. Moon is Professor of Science Ed., California State College, California, PA

Since the days of Gifford Pinchot, the conservationist who served as governor in the 1920's and again in the 1930's, Pennsylvania has paid considerable attention to environmental education. By 1970 its schools had approximately 90 outdoor education programs, 135 outdoor laboratories, and 540 schoolground activities.[3] On July 1, 1969, Pennsylvania's State Board of Education directed that every school require some kind of study in environmental education, conservation, and outdoor recreation. Such action necessitates a need throughout the Commonwealth for those teachers trained in environmental education who can promote pupil awareness of the total environment. Among the responsibilities of such teachers would be the task of developing and implementing a comprehensive, inclusive program for public and/or private schools which relate environmental education to all disciplines at all grade levels.

In an effort to help elementary school teachers meet such responsibilities, California State College has generated an environmental education workshop. Certainly there is no one ideal approach to teaching such a course in environmental education, for the very term itself envisions an interdisciplinary framework that attempts to demonstrate that modern man must live in harmony with nature; thus such a course could be approached through many avenues. The approach that this course has taken reflects an ecological flavor. The course is offered during the college's summer sessions, and revolves around both field and laboratory studies. General topics include discussions on introductory taxonomy, populations and biotic communities, ecological succession, basic terrestrial and aquatic biomes, and environmental pollution. The primary objective of this course is to suggest how these concepts can be translated into appropriate learning activities for elementary school children.

Two of the more recent national curricular programs in elementary school science that have been used successfully are some of the life science units of the Science Curriculum Improvement Study and selected Elementary Science Study activities. In regards to SCIS, Roberts and Dyrli write that: "... By supplementing the life science sequence of this project with a distinct social dimension, a very strong recommendation can be made for designing a program of environmental education around these well-developed laboratory-centered units."[4] Within both the laboratory and field, teachers are given opportunities to consider the interdependence of distinct populations of plants and animals within different biological communities through food chains and food webs and through such biogeochemical cycles as the oxygen-carbon dioxide exchange between plants and animals. Additional SCIS activities that are presented stress the effects of environmental pollution in natural ecosystems; studying thermal pollution effects on Daphnia have been particularly successful.

Selected Elementary Science Study materials have also been valuable. The unit focusing upon behavior of mealworms demonstrated how organisms can respond dractically to stimuli within their environment. The ESS unit entitled Microgardening graphically conveys to in-service teachers the important ecological niches that decomposers such as bacteria, molds, and other fungi occupy. The units entitled Small Things and Pond Water are also useful in depicting the diversity of microscppic

[3]National School Public Relations Association, Environment and the Schools Washington, D.C., 1971, p. 12

[4]SCIS Newsletter, No. 21 (Fall, 1971), p. 4.

life --- such microorganisms often demonstrate environmental relationships that parallel those found among larger organisms, such as predator-prey interactions.

Field trips to surrounding woodlots and aquatic communities are essential. Different samples of soil are collected in varied habitats to demonstrate the diversity of life in soil communities. Classification exercises are stressed using insects and leaves to reflect this important science process skill. Free pamphlets produced by the Department of Environmental Resources in Harrisburg, such as Common Trees of Pennsylvania, have been especially useful. Excursions to local water treatment plants and surrounding industrial sites concerned with the human implications of environmental quality control are also arranged.

Many films and film loops have been produced recently that nicely describe underlying concepts in environmental education. One such series that has been particulary helpful in describing man's effects on basic world biomes has been produced by Encyclopedia Britannica.

There are many textbooks that have been recently published in the area of environmental education that are acceptable for such course activities. Three such texts that have been very useful are all produced in paperback form and are readily accessible to the in-service teacher. One of these texts, Environmental Education in the Elementary School[5] represents a compilation of articles from Science and Children, many of them written in the past two years. C. H. Southwick's book, Ecology and the Quality of Our Environment,[6] also is excellent as an introductory text that attempts to integrate the principles of ecology with the social and environmental problems of man. Although Buchsbaum's Basic Ecology[7] was first published in 1957, it still is valuable reading as an introduction to ecology for the in-service teacher.

---

[5]Environmental Education in the Elementary School, Washington, D.C.: National Science Teachers Association, 1972.

[6]Charles H. Southwick, Ecology and the Quality of Our Environment, New York: Van Nostraud Reinhold Company, 1972.

[7]Ralph and Mildren Buchsbaum, Basic Ecology, Pacific Grove, California: The Boxwood Press, 1957.

SUMMARY

Science educators are cognizant of the fact that there is a definite need for teachers in all areas of education who both can appreciate the ideal role of man living in harmony with nature and can effectively translate this role to others. Environmental education workshops such as the one described here can help teachers meet these responsibilities.

A COMPARISON OF TWO METHODS OF PREPARING PROSPECTIVE ELEMENTARY TEACHERS TO TEACH SCIENCE

by

Norwood P. Lawfer

The emphasis in teaching science to elementary school children is shifting from the lecture and demonstration type format to an individualized inquiry type program. This is very much in evidence in the alphabet soup programs of SCIS, COPES, ESS, and SAPA. How important is the inquiry type program in the preparation of elementary school teachers? The study reported here tried to compare two basic methods as they pertained to the preparation of elementary teachers.

The subjects for the study consisted of four sections of prospective elementary teachers entolled in the course "Science for Elementary Schools" at Kutztown State College, Kutztown, PA. The final enrollment totaled 98 of which 6 students were randomly pruned to equate the sections so that the analysis of variance could be used to statistically analyse the data. The sections were initially compared using age, marital status, student classification, sex ratio in sections, College Entrance Examination Board score means and college quality point average. This comparison indicated that the four section were similar and

---

Dr. Lawfer is a Professor of Science Education at Kutztown State College, Kutztown, PA

representaive of the population.

Two instructors were used in the study. Each instructor taught a lecture-laboratory group and an inquiry group. Both instructors were men.

The lecture-demonstration groups used a different laboratory than the inquiry method groups. There was no verbal or written reference to "lecture" or "inquiry" groups. Since the only observable difference between the groups outside of the classroom was the schedule sequence, the "Hawthorne Effect" was reduced to the minimum.

The content of the course for both groups was based upon the publication A Workbook for Science in the Elementary School, Lawfer, 1969. This workbook was developed by the investigator during the span of several years. Originally, the unit exercises were developed as part of a course in elementary school science under the direction of Dr. Williard Jacobson, Teachers College, Columbia University. The outlines were field tested, revised and published in 1967.

The classes using the inquiry method were divided into groups of two or three students. Materials, supplies, and equipment needed for the inquiry groups were adequate for class enrollments up to the number of 26. Duplicate and triplicate equipment was supplied where needed. Approximately 40 physics, chemistry, physical science, general science, and elementary science text books were available in the laboratory. The instructor served as a resource person. Individual and small group questions were answered and suggestions for the unit exercises were given to each group as needed, but no formal lecturing or demonstrating was pursued by the instructor.

The classes using the lecture-demonstration method required only one set of materials and equipment. Equipment could be set up ahead of time for use in the demonstrations. The instructor controlled the sequence and the time spent on each exercise within the unit. Certain exercises were demonstrated by the instructor, others were demonstrated under the tutelage of the instructor. Background information pertaining to the units was presented by the instructor in the form of lectures.

Achievement was measured using an instructor made multiple choice examination. The test was developed over a period of two semesters. Initially, a table of specifications was used. The 85 items comprising the test were uniformly distributed and selected from units covered in the course of study. The coefficient of reliability was calculated using the Kuder Richardson formula 21 and found to be r=.67. The pilot test was revised on the basis of these analyses and administered the next semester. The coefficient of reliability of the second examination was r=.74. Since the second pilot examination was considered to have sufficient reliability, the test, with minor corrections, was administered to the groups involved in the study. The coefficient of reliability remained sufficiently high r=.68.

The Test on Understanding Science (TOUS), developed by W.W. Cooly and L.E. Klopfer, was used to measure the amount of understanding acquired about the nature and methodology of science. The test is printed and sold by Educational Testing Service, Princeton, New Jersey. The test reliability as reported by the authors was quite high r=.76. The reliability as calculated from the data of the test groups involved in the study was r=.59.

The "Allison Adaptation of the Allen Attitude Scale," was used to evaluate attitude toward science and scientists. The original scale was developed as a part of the Science Manpower Project, Teacher College, Columbia University. Allison reported coefficients of reliability of r=.97. When the coefficient of reliability was calculated on one section using the method of equivalent halves it remained quite high r=.81.

A 2X2 factorial analysis of variance enabled the investigator to compare both instructor and method variables. Analysis of the data gathered by the instructor mentioned above indicated that there was no significant difference between groups with either variable at the .10 level of significance. There was significant interaction at the .05 level of significance indicated by the analysis of the data with the total test on understanding science and the attitude scale. A factor or factors were influencing the data which could not be isolated by the design of the study.

In an informal and subjective evaluation of the groups, the instructors noted that of the 92 students who took part in the study, four indicated that science was their area of specialization . This amounted to four percent of the sample. Soy (1967) in her study of the attitudes of prospective elementary teachers indicated that seven percent of her sample of 422 chose science as a subject area in which the student felt prepared to teach. Probably sample size can account for some of the difference in percentage but at any rate the study of science as pertaining to the elementary school is not a popular subject.

The general attitude of the lecture groups seemed to be more formal as compared to the inquiry groups. Students seemed more secure in the lecture demonstration laboratories where all aspects of the units were planned and no decisions were required of the individuals. Although there had been assinged work to be done outside of class, the instructors felt that students depended primarily upon the teacher to supply the information for the particular unit. Very little science reading was done outside of the class by the students who were enrolled in the lecture sections as evidenced by the questions posed by students during the demonstrations.

The groups exposed to the inquiry method exhibited more individual effort, more amsll group effort, and no small degree of initial confusion. The confusion resulted from the marked change in the class format from the usual science class experience. The students in the inquiry type program required a maximum of two weeks to adjust. Certain student relished the relative independence of the inquiry method while others depended heavily upon instructor aid.

The researcher observed that although all units could be adapted to use either method of instruction certain units could be taught more effectively using one method or the other. The researcher thought that a combination of methods could be used more effectively than one method in particular. Other studies recommended that method and course objectives be evaluated before structuring any science course.

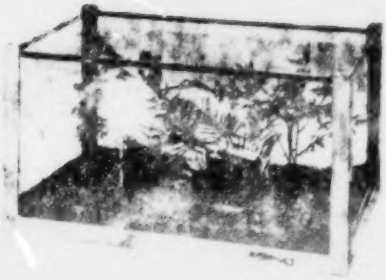
SUMMARY

When the data derived from the achievement examination, the understanding science examination, and the attitude scale were statistically analysed; no advantage in either the lecture demonstration method or the inquiry method could be discerned. The investigator hypothesized that for young adults basic science understandings and attitudes had been stabilized before exposure to either type method at the college level. A second sypothesis might state that the methods did produce a difference between the groups but was not detected by the measuring instruments. Since the inquiry method involved the broader aspects of science and the ability to apply concepts and generalizations to a specific problem, a compartmentalized test cannot be used to evaluate the results by using the inquiry method of teaching.

The inquiry method has been touted as the progressive way to teach science to elementary children. According to the data of the study the inquiry method does not hold out such promise to the prospective elementary teacher.

Lawfer, Norwood P. A Workbook for Science in the Elementary School Berkeley, Cal McCutchan Publishing Cops., 1969

Soy, Eloise M. "Attitudes of Prospective Elementary Teachers Toward Science as a Field of Specialty." School Science and Mathematics, 67:6 (June), p.507.



PUPIL ACHIEVEMENT IN SCIENCE A PROCESS APPROACH

by

William Torop
West Chester State College

The problem considered in this study was to determine to what extent elementary school children were achieving the objectives of Science A Process Approach[1] (SAPA). SAPA is a sequential general science program for grades kindergarten through six. In the primary grades attention is focused on the basic scientific processes of observing, inferring, classifying, using numbers, measuring, using space/time relationships, communicating, and predicting. The intermediate grades focus on the integrated processes of defining operationally, formulating hypotheses, controlling variables, interpreting data, and experimenting.

Each exercise is organized around one of these processes and its related skills. These skills are defined in terms of observable performances or behaviors of the pupil and are prepared for each exercise. Except for certain data sheets there are no printed materials prepared for the pupils. Together the exercises form a hierarchy in which one process contributes to the pupil's capabilities in other processes. Although the exercises should not be used out of sequence, the teacher is free to handle the lessons in any way that will achieve the specified outcomes.

William Torop, West Chester State College

The teacher booklets also contain, for each exercise, a rationale, vocabulary, list of required materials, instructional procedure, a generalizing experience, appraisal, and competency measure. The instructional procedure is the general teaching methods suggested for each of several activities in the exercise.

Evaluation is an important part of the SAPA program. The appraisal is a group test that provides immediate feedback on overall class performance. Competency measures are individual achievement tests of several tasks ranging in number from two to fourteen. Each task assesses the attainment of one or more of the behavioral objectives listed for the exercise and the tasks are so labeled. These tasks have been carefully tested with tryout groups involving 7000 children over a three year period.[2] The tasks are intentionally designed to use content material different from that of the exercise. The tasks focus on observable behaviors rather than the recall of memorized facts or the recognition of familiar objects. In this way, one can assess the transfer of learning and ability to generalize. The individual competency measures are the instruments administered in this study.

PROCEDURE

The subjects were pupils in the seven evementary schools of Marple-Newtown School District, Newtown Square, Pennsylvania, during the school year 1970-1971. The 1970-1971 school facilities consisted of seven elementary schools, two junior high schools, and one senior high school. Enrollment in the ten schools was more than 7800 students.

Beginning with Part A in kindergarten, during the school year 1966-1967, the SAPA program was installed in the Marple-Newtown School District by adding one grade each year as the pupils progressed through the program. Thus, during the year of the study, 1970-1971, the SAPA program was functioning in grades kindergarten through four. This was the first year of the program in grade four.

The teachers were given a sheet with a list of random numbers[3] and asked to copy their roll, in alphabetical order, on this sheet. They were then asked to administer the individual competency measure tasks for the first exercise taught to the pupils whose names appeared after numbers one and two on the sheet. For the second exercise taught the teachers were asked to administer the competency measure to pupils numbered three and four, and so on through the list for the other exercises as they were completed. If a number was blank (no pupil's name next to it), the teachers were instructed to go on to the next number. Two pupils, selected in this random fashion, in each class for each SAPA exercise taught, were given the competency measure for the particular exercise. This involved a total of 3,982 competency measures. It was during this time period that the investigator[4] served as an Elementary Science Consultant in the Marple-Newtown School District.

RESULTS

Percentages of correct responses were computed for individual exercises in each Part. The average percentage of correct responses for each exercise in each grade are summarized in Table I.

Similar results have been previously reported.[5]

TABLE I

SCIENCE A PROCESS APPROACH COMPETENCY MEASURE PERFORMANCE
IN MARPLE-NEWTOWN SCHOOLS 1970-1971

PERCENTAGE OF CORRECT RESPONSES

PARTS A THROUGH E

Exercise Letter	Part A	Part B	Part C	Part D	Part E
a	98	95	89	91	82
b	97	84	79	78	82
c	94	79	81	91	81
d	96	92	85	80	78
e	96	95	87	88	83
f	94	88	91	79	73
g	92	82	87	93	82
h	85	94	90	79	89
i	87	92	78	77	80
j	97	90	80	92	87
k	96	92	94	83	73
l	93	84	84	85	83
m	97	91	87	88	78
n	90	93	81	86	83
o	91	96	82	88	86
p	96	88	83	99	89
q	93	83	83	96	87
r	79	98	82	88	89
s	100	90	87	86	88
t	95	89	88	81	80
u	87	88	100	82	80
v	94	94	92	87	90
w	**	91	90	**	67
x	**	93	**	**	**
y	**	90	**	**	**
z	**	83	**	**	**
Number of Pupils tested	438	1048	904	782	810

LIMITATIONS OF THE STUDY

The major limitation of this investigation was that each teacher administered the competency measure herself and was the sole judge of the acceptability of any answers given by the pupils. Although each teacher asked identical questions for each exercise, and possessed an identical set of correct responses, some variability undoubtedly occurred in the testing situations. Teacher expectancy, a questionabile phenomenon which may effect the results of psychological research,[6] could also have had an unknown effect on the obtained results.

A final limitation is the type of school district. This factor severely limits the generalizability of the results to other schools, such as found in the inner cities.

CONCLUSION

SAPA was originally designed so that 90% of the pupils should achieve 90% of the stated objectives. There has been no extensive published evaluation of the final version. The evaluation report of the experimental version indicated that Part E was less successful that Parts A through D.[7] This same trend can be observed in the final version of Part E in Marple-Newtown. The present figures, however, indicate that the objectives of the program are being achieved in the Marple-Newtown School District.

Figures for individual exercises indicate which exercises might need improvement--either in the teacher's guide itself or the questions that are asked of the pupil in the competency measure.

SUMMARY

The problem considered in this study was to determine to what extent elementary school children were achieving the objectives of Science A Process Approach. Two pupils, selected randomly, in each class for each SAPA exercise taught in the Marple-Newtown School District, were given the competency measure for the particular exercise. The results indicate that the objectives of the SAPA program are being achieved in this district. Figures for the individual exercise provided will indicate to those teachers using the SAPA program which exercises might need improvement - either in the exercise itself or the compentency measure.

REFERENCES

1. Developed by the Commission on Science Education of the American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington, D.C. 20005

2. An Evaluation Model and Its Application. Second Report. Commission on Science Education. Washington, D.C.: American Association for the Advancement of Science, 1968. Miscellaneous Publication 68-4.

3. Selected from Edwards, Allen L. Statistical Methods for the Behavioral Sciences. New York: Holt, Rinehart & Winston, 1954. Table I, pp. 472-476.

4. The investigator is Director, Delaware Valley Institute for Science Education (DEVISE), West Chester State College, West Chester, Pennsylvania.

5. Torop, William. Pupil Achievement in Science A Process Approach. Contributed Paper, NARST Annual Meeting, March 24, 1971, Silver Spring, Maryland.

6. Gephart, William J., and Daniel P. Antonoplos, "The Effects of Expectancy and Other Research-Biasing Factors," Phi Delta Kappan, 50, 579-583 (1969)

7. An Evaluation Model and Its Application, loc. cit.

Science Activities and the Retarded Child

by

Donald A. Vannan

Just because a child has been classified as "retarded" or as a "slow learner" does not mean that he has no interest in science in the elementary grades. This child, too, along with extroverts, introverts, gifted, talented, "advantaged," and "disadvantaged," should have opportunities in science to meet his or her needs and interests. Perhaps science can lead a withdrawn, disinterested child out of the morass of marginal participation into the excitement of involvement.

In general, we find that the retarded child has special deficiencies in the areas of reading and mathematics (both highly abstract). In light of the deficiencies, we must be extremely careful not to frustrate this student with an overabundance of reading or with mathematical concepts and operations on which he must work in a slow and painstaking manner. He should be given activities which involve the greatest possible number of senses, those which

---

Dr. Vannan is a Professor of Education at Bloomsburg State College, Bloomsburg, Pennsylvania.

involve not only the generally exposed areas such as seeing and hearing, but those which involve tactile and kinesthetic senses as well. Running his fingers over a plaster-of-Paris model of the minor land forms means much more to this child than hearing that "plateaus are high, even ground," and "plains are low, even ground." He needs the words, yes, but he needs also the tactile sense stimulation which aids his understanding and retention of concepts.

Following are selected resources to which the reader may refer after skimming the abstracts:

(1) In Guiding the Retarded Child (Baumgartner), the author indicates that the primary purpose of a science program not only provides the "educable mentally retarded" children with meaningful, sequential experiences, but also allows expression of special interests in a systematically planned program. As a result, the environmental science program helps these children to understand the "how and why" of daily living in their present, as well as future, lives.

(2) Thresher informs us in Mental Retardation ("Science Education for Mentally Retarded Children: A Rationale") that while formal science instruction proved to be an important contribution to elementary curricula, we have overlooked science in special education, though their goals are similar. Along with qualified teachers and regular or adapted science equipment and texts, the content should be presented in a logical, sequential way and science terms and concepts understood operationally through active participation by retarded children, despite their limited abilities.

(3) In Chapter 11 of The Education of Slow Learning Children (London), A. E. Tansley and R. Gulliford relate that the curriculum, in elementary special classes, should include some science topics which can be applied to home, work, and leisure-time activities. In addition, the approach should be one of verification and problem solving, with the children doing their own experiments whenever possible.

(4) Working with the mentally retarded in science education should involve experiences which hold significiance for the children, utilize many methods, enlarge the world around the children, and select experiences which can lead to generalizations. Also, we should stress fredom and inquiry, as well as illustrating the relationship and connections between the science being taught and other major disciplines in life. (G. Orville Johnson, Education for the Slow Learner. Prentice-Hall).

(5) Some good general points for all instruction in the elementary school are described by Merle Karnes in "The Slow Learner . . . What Are His Characteristics and Needs?" in Today's Education. The author, among other points, informs us that these children are not as "curious and creative," "have a hard time following directions," and have "poor work habits." Additional points include the characteristics of "short attention span," need for "over-learning," and slowness in "seeing cause and effect relationships."

(6) Today's Education, also has an interesting article by T. P. Quayle in which he states that tape-recorded excerpts from textbooks are available. Perhaps a concerted effort by teachers could result in all companies starting this interesting sidelight to improve their science programs.

(7) Kathryn Froiseth states that children might be helped initially by finding success in a single objective and by using science and social studies teams. (The Instructor). She also cautions that separate projects should consider the qualitative abilities of the slow and the gifted child. There is more in her article "Reach the Top and Bottom Children."

(8) In "Teaching the Slow Learner," Today's Education, Regis Crowley emphasizes the fact that we should not deal in abstracts but should concentrate our efforts in concrete, practical explanations. The author further points out that we should help to project the slow learner into his future and that we should be especially careful about his attitude toward his work in the classroom.

(9) Author Will Ross ("Unit Boxes Aid Teaching Science to Slow Learners," The Science Teacher, enlightens us with information concerning a box of materials used by slow learning children. The box opens to form the sides of a study space and can be used to hold the interest of the student and minimize outside distractions. Some of the boxes contain tape recordings and records to cover a basic approach to the subject matter. Sometimes picture clues are attached to the inside cover of the box, aiding the child in knowing what to do.

(10) In "Science for the Educable Retarded" (Science and Children), Paul Katz comments that simple and basic experiments in the field of science can help bridge the gap from concrete to abstract for the mentally handicapped. He also poses the question, "Can we afford not to include this (science) area of learning (in the curriculum of the retarded)? He reemphasizes the importance of the achievement of vocational and social competence for the retarded child.

Summary

In brief, these are selected sources for the special education teacher as well as for the teacher of regular classes in the elementary school. The main point of each of the articles seems to be "include science; the retarded will benefit."

THE IMPACT OF SELECTED NATIONALLY RECOGNIZED SCIENCE CURRICULUM PROJECTS ON PROGRAMS TO PREPARE PROSPECTIVE ELEMENTARY TEACHERS TO TEACH SCIENCE

by

Gene F. Craven
and
John M. Mason

One of the persistent problems in science education is the preparation of elementary teachers to teach science. The problem has been compounded during the past decade by curriculum projects that have replaced student texts with teacher's guides and emphasis on subject matter content with emphasis on processes of science. While pilot projects to test and implement the curriculum materials included extensive teacher training in the desired use of the materials, a relatively small number of teachers and practically no pre-service teachers have benefited directly from project sponsored training. Thus, teacher training institutions are in a key position to facilitate the implementation of the "new curriculum materials." It is hypothesized that their effectiveness in doing so depends upon the availability of the project materials to science educators who are familiar with their intended use.

This paper summarizes the findings of a 1971 nation-wide status study to determine the impact that selected "new" science curriculum projects may have had

---

Gene F. Craven, Science Education Department, Oregon State Univeristy, Corvallis, Ore.
John M. Mason, School of Education, Michigan State University, East Lansing, Mich.

on the instructional methods and procedures employed in college or university programs designed to prepare prospective elementary teachers to teach science in the elementary school.

With no available listing of college and university instructors who were responsible for pre-service elementary teacher education programs, approximately 2,000 questionnaires were mailed to persons who were members of either the Association for the Education of Teachers of Science (AETS) or the National Association for Research in Science Teaching (NARST) and to Deans of Education at four year colleges and universities throughout the United States. Recipients of the questionnaires who were not teaching a course in the teaching of science in the elementary school were asked to forward the questionnaire and an accompanying letter of explanation to persons having such an assignment.

Five hundred and eighteen completed questionnaires were returned. An analysis by National Science Teacher Association (NSTA) District revealed a significant return from all sections of the country. The returns ranged from a low of 22 from District V (Alabama, Florida, Georgia, Mississippi) to a high of 97 from District II (New Jersey, New York, Pennsylvania). Fifty-nine percent were from public institutions with enrollments less than one thousand, approximately one-third were from institutions with enrollments over ten thousand.

Although it was recognized that many elementary science projects may have had an impact on the preservice methods courses in the teaching of science at the elementary school level, this study was limited to the three which were considered to be the most widely disseminated in May 1971 when the study was undertaken. These were: Elementary Science Study(ESS), Science A Process Approach (SAPA), and Science Curriculum Improvement Study (SCIS). In this paper, the phrase "new science curriculum projects" refers specifically to the ESS, SAPA, and SCIS projects.

INSTRUCTOR EXPERIENCES WITH THE PROJECTS

One-third (32%) of the 518 respondents indicated that they had been associated either directly or indirectly with all three of the projects. However, nearly as many (31%) reported having had no association with any of projects. Less than five percent had been associated as a writer on any of the projects.

Nearly two-thirds (64%) of the science educators had participated in workshops or training sessions to familarize the participants with one or more of the projects. Less than half (41%) had attended workshops or training sessions to provide leadership training for conducting trial centers for one or more of the projects.

Some impact of the "new science curriculum projects" may be inferred from the fact that over half (54%) of the respondents had conducted workshops or training sessions that covered one or more of the projects. More of these had been designed to implement SAPA alone or in combination with another project than for ESS or SCIS which followed in that order.

IMPACT ON THE COURSE IN TEACHING SCIENCE

Nearly four in five (79%) of the science educators sampled reported that the "new science curriculum materials" had had a definite impact on the nature of the preservice methods course in the teaching of science in the elementary school. The greatest effect, that identified by eighty-four (84%) percent of the respondents, was instructional procedures which emphasize the processes of

	SAPA			ESS			SCIS		
	AVAILABLE	AVAILABLE-NOT USED	NOT AVAILABLE	AVAILABLE	AVAILABLE-NOT USED	NOT AVAILABLE	AVAILABLE	AVAILABLE-NOT USED	NOT AVAILABLE
Materials not Common to all of the Projects	Teachers Commentary 64%	(5%)	(36%)	Supplementary Science Readers 30%	(---)	(70%)	Elementary Sci. Sourcebook 62%	(10%)	(38%)
	Behavioral Heirarchy Charts 74%	(17%)	(20%)						
One or More Teacher's Guides or Units	54%	(11%)	(46%)	64%	(8%)	(36%)	60%	(7%)	(40%)
All of the Teacher's Guides or Units	18%	(---)	(82%)	12%	(---)	(88%)	26%	(---)	(74%)
One or More Equipment, Supply, or Materials Kits	41%	(21%)	(59%)	55%	(9%)	(45%)	40%	(17%)	(60%)
Kits for All Units Which are Available	7%	(--)	(93%)	4%	(---)	(96%)	13%*	(---)	(87%)
	SAPA			ESS			SCIS		

*Five or more units.

Table I

science. The data suggest that the new project materials had definitely influenced the science content of the course taught by seventy-one (71%) percent and had been influential in the selection of texts for the course taught by sixty-one (61%) percent of the respondents.

The project which was reported as having had the greatest influence upon the course science content was SAPA (27%), followed by ESS (16%) and SCIS (14%). One-fifth of the science educators indicated that the science content was influenced most by a combination of the projects or to other curriculum sources. One-third (31%) reported that the activities used in the course to emphasize the processes of science had been drawn about equally from all three projects. The project that had been used most frequently for this purpose, according to the respondents who did not indicate the use of all three equally, was SAPA (22%), ESS (12%), and SCIS (6%). Thus, one may infer from these findings that process skills were emphsized more than they had been previously, that some change in emphasis of the course content had taken place, and that different activities to illustrate methods for the teaching of science had resulted from the projects.

Additional impact may be inferred from the activities required of students in the courses where the project materials were being used. The students, in a majority (71%) of the cases reported, were required to examine some or all of the Teacher's Guides or Units for the projects. In approximately half (51%) of the cases, the students had to critique one or more of the projects; in less than half (45%) they were required to use the projects as models for lesson planning; and in slightly over half of the cases, the students were required to teache a microlesson (57%) or make a class presentation (55%) based upon an activity from at least one of the projects.

AVAILABILITY OF PROJECT MATERIALS

The data with respect to the availability of the project materials at the institution where the respondent was teaching (Table 1) indicate that while one or more teacher's guides or units were available to a majority of the 518 respondnets, a relatively small percentage reported having all of the guides or units available for any of the programs. Preliminary or experimental editions of SAPA were being used by over one-fourth (27%) of the respondents. This finding could be interpreted as an early influence of this project upon the course taught by those science educators having access to these materials.

Less than a majority reported that one or more equipment, supply, or materials kits were available for any of the projects. It should be noted that several of the respondents wrote comments to the effect that a lack of money and the relatively high price of the kits were factors in not having them available for implementation of the respective programs.

SUMMARY

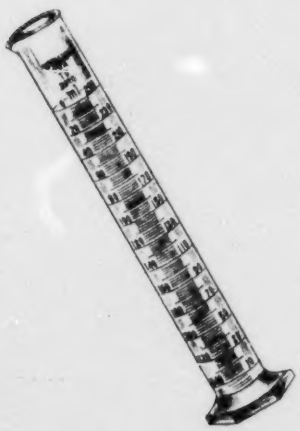
The purpose of this nation-wide status study was to determine the impact that selected "new" science curriculum projects may have had on the instructional methods and procedures employed in college and university programs to prepare prospective teachers to teach science in the elementary school. Analysis of 518 questionnaires completed by instructors of preservice elementary science methods courses revealed that while few participated in at least one workshop or training session to familarize the participants with one or more of the projects, and had, in turn, conducted at least one workshop or training session

that covered one or more of the projects.

Over three-fourths of the respondents indicated that the projects had had a definite impact on his methods course with respect to (a) instructional procedures which emphasize the processes of science, (b) the texts used in teaching the course, and (c) the science content included in the course. SAPA was reported as being the program from which activities were most frequently drawn to emphasize the processes of science and was the program most commonly reported as having had the greatest impact upon the course science content. It should be noted, however, that a higher percentage of the science educators reported having one or more ESS or SCIS teacher's guides or units, and more ESS materials kits available than was true for SAPA. The disclosure that more than one-fourth of the respondents were using the preliminary and experimental SAPA editions may reflect an early influence of this project on the courses taught by science educators having access to these materials.

The relatively high cost of materials kits was cited as being a major factor in their unavailability for implementation of the ESS, SAPA, and SCIS materials in the teacher training programs at many of the institutions.

In conclusion, while the "new science curriculum materials" produced by the projects identified for inclusion in this study appear to have had a definite impact on preservice methods courses on the teaching of science in the elementary school, it should be noted that nearly one-third of the science educators who participated in the study reported having had no association with these projects. Also, one fifth of the respondents indicated that these projects had had little, if any, impact upon the nature of his course in teaching science in the elementary school.



PRE-SERVICE SCIENCE EDUCATION 'N A FOUR STATE AREA*

STATEMENT OF THE PROBLEM

It is the purpose of this study to (1) examine the status of teacher-trainee preparation of selected new elementary science programs in methods classes: (2) identify characteristics of the methods courses; and (3) examine opinions of the instructors about the new science programs. It is hypothesized that there will be no significant differences among rank of instructor of location of school by state on the questions comparing instructors' opinions about the new programs.

For the purpose of this study, new science refers to the major experimental programs in elementary science. References are made to American

---

*Avdul, Richard N. "An Investigation of the Status of the New Elementary Science Programs in Teacher Training Institutions of Ohio, Kentucky, Pennsylvania and West Virginia." Unpublished Doctor's Thesis, Ohio University, Athens, Ohio. 1970.

Association for the Advancement of Science (AAAS), Conceptually Oriented Program in Elementary Science (COPES), Elementary Science Project (ESP), Elementary Science Study (ESS), Elementary School Science Project (ESSP, California, Illinois, Utah), Intermediate Science Curriculum Study (ISCS), Minnesota Mathematics and Science Teaching Project (MINNEMAST), School Science Curriculum Project (SSCP), Science Curriculum Improvement Study (SCIS), and the Quantitative Approach to Elementary Science.

THE PROCEDURE

Responses were collected from 133 instructors of elementary science methods courses representing 94 colleges/universities from Ohio, Kentucky, Pennsylvania, and West Virginia. The findings of the study were based on the data obtained from a questionnaire survey. Questions from the first portion of the instrument called for multiple-choice and open-ended responses. The second portion of the questionnaire called for responses relating to questions on opinions about the new science curricula. Subjects responded to one of four choices labeled "Very significant," "Moderately significant," "Slightly significant," or "Not at all significant."

Data were subjected to statistical analysis using item analysis, correlation tests, and chi-square tests for significance.

MAJOR FINDINGS

The most significant findings of this study are:

1. Respondents do indicate commitment to the new elementary science curricula.

2. The importance of providing elementary school teachers with training in the new science programs is recognized by the majority of the respondents.

3. Opinions about the new courses do not differ by respondents regardless of location of school or academic rank.

4. Approximately 50 percent of university instructors reported teaching the AAAS, ESS, and SCIS programs. Instruction in the new sciences was designated primarily as introductory - descriptive rather than preparation for teaching. Over 80 percent of the respondents gave no attention to ESP, ESSP (California, Utah), ISCS, SSCP and Quantitative Approach.

5. Lack of new science materials was reported by 44 percent of the respondents.

6. Over 60 percent of the universities where enrollment exceeded 2,000 expended less than one-fourth of their science budgets on new science materials.

7. Approximately one-half of the universities where enrollment exceeded 5,000 reported new science expenditures at less than $75 per year.

8. Types of new science materials found in university classrooms vary considerably and are found only in limited quantity.

9. Personal interest in developing new programs and reading about them are significant factors that influenced respondents for teaching the new sciences in their classes.

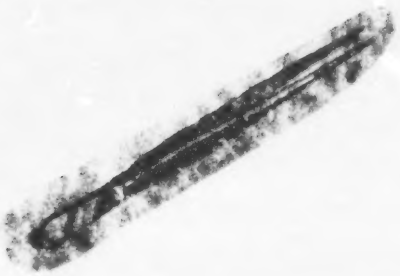
10. In the opinion of the respondents, the major obstacles for implementing new science curricula into the elementary schools include lack of teacher training and lack of educational theory for teaching science, lack of desire for changing the established science programs, and the costs of the new programs.

11. Insufficient time in the school day or "conservatism" in elementary schools are not considered by the respondents as problems in implementing new programs.

12. The findings disclose that the respondents believe that teaching the new sciences is necessary to (1) stimulate the professional growth of teachers, (2) promote self-confidence in classroom teaching, and (3) generally improve classroom performance.

RECOMMENDATIONS

Based on these findings, it is recommended that all teacher education programs include in the preparation of prospective teachers training in more than one of the science-process approaches. Additional funds should be appropriated so that prospective teachers can experience the new programs in the same manner children will experience them in the classrooms. Research is also needed to determine the degree and methods in which prospective teachers are being trained in the process approaches.



Individually Paced Science Education: A Humanistic Approach

by

Lynn Oberlin

In the program for elementary teachers at the University of Florida, several "new ideas" are being put into practice. These include no A, B, C letter grades, no regularly scheduled classes, a program paced to the student that can be finished in varying lengths of time, students and faculty planning together with the students responsible for their learning, and field experience provided in the public schools during junior and senior years.

This is a truly humanistic program patterned from The Professional Education of Teachers: A Perceptual View of Teacher Education by Arthur Combs. The ideas that one learns best when he has self direction, learning is relevant, and is adjusted to his needs; and that theory is closely related to practice are being put into operation. By the way, this program does not cost any more than the traditional ones.

The new Elementary Program (NEP) was experimental at first. After

---

Dr. Oberlin is an Associate Professor of Science Education at the University of Florida, Gainesville, Florida.

three years, the Department of Childhood Education decided to have NEP as its only program, renaming it the Childhood Education Program (CEP).

The seminar is very important to the program. Each new student is assigned to a group with 29 others. They stay together as long as they are in the program and work with the same seminar leader whenever possible. Groups of 15 students meet two hours a week to discuss any problems---with program, the practice teaching, or their doubts. Seminar leaders provide guidance, open discussion, and counseling.

The field experience is on four levels: Teacher Initiate with six hours a week in the public schools, Teacher Assistant and Teacher Associate in the schools ten hours per week, and intensive teaching which is five weeks of full time teaching during the final quarter. The college has no formal supervision but faculty members visit the classroom when requested.

Areas of education in mathematics, science, art, music, psychological foundations, sociological foundations, reading, social studies, language arts and curriculum have instructors that make up the substantive panel. Each faculty member has a list of learning activities for students to complete. Some are required, some are elective, and others may be suggested by students. Orientation sessions are required in each area. In science, students are required to complete six learning activities including the orientation sessions. In three areas, students must do extra work. If they should choose science, going beyond the minimum means doing one additional learning activity, either from the list or suggested by the student.

Even though letter grades are not given, evaluation exists. There is an assessment of the college work of the student when he enters the program. Plans are made to correct any deficiencies. Halfway through the program the seminar leader and one or two members of the substantive panel review (with the student) work accomplished and plans for the future. At this time the student should know when he plans to complete his work. Continuous evaluation in the seminar and in each substantive area is constantly taking place. If the student completes an activity successfully, he is given a learning activity slip. If it is not satisfactory, he is asked to do it over and submit it again. Field experience in the public schools is also evaluated. A final evaluation takes place just before graduation and consists of the student, seminar leader, and one or two panel members reviewing the student's entire record. If this record is satisfactory, the student is recommended for graduation and certification. A letter, which becomes part of the student's permanent record, is written by the seminar leader. This letter uses comments on strengths and weaknesses of the student from his substantive professors, has an assessement of his ability to teach, and also his probability of success in graduate school.

The science education component of the C.E.P. is given below.

SCIENCE LEARNING ACTIVITIES

Complete six of the following. The first four are required. Orientation sessions are a prerequisite to other activities. Science content competence is required of all students. It may be demonstrated during orientation or at other scheduled times. Science content competence is shown by the student

completing a standardized general science test with a score at or above the 75th percentile for end of the year ninth grade students. About half of the students do not meet this standard on their first try and a science content module is available for those who need to become more proficient.

*1. Attend Science Orientation Sessions.
Three one hour sessions are required.

*2. Learn to use the Science Teacher Observation Rating Form (STORF) and demonstrate competence observing two taped situations. As a member of a three person team, observe (with the STORF) at least two science lessons being taught and teach at least one lesson which is observed (with the STORF) by two team members. The STORF is an instrument used to observe the practices of teachers working with children in the area of science. It was developed at the University of Florida by Lynn Oberlin.

*3. Learn about new programs in elementary school science (AAAS, ESS, SCIS.) Examine and perform the activities for six units. This must include at least two of the programs.

*4. Develop plans and materials, and use four of the following techniques in teaching scienct to children:
a. Science Center Component b. Counterintuitive (Discrepant Events) c. Pictorial Riddles d. Open-ended Investigation e. Inductive Teaching.

5. Select and carry out two laboratory investigations in each of the following areas: a. Physical Science b. Life Science c. Earth Science. (Three different sources are required.)

6. Present evidence that scientific information has been learned in two areas of physical science and two areas of biological science. Two sources of adult material must be used for each area. (Areas must be narrow in scope.)

7. Demonstrate an understanding of the "Processes of Science." (Module Available.) A module is available for students to work with. When a student thinks he is ready, he arranges to take a test on processes of science. If a score of 80% or above is obtained, he is given credit for their activity. If not, there is another form of the test and he can try again.

#8. Plan and teach a science <u>UNIT</u> (several lessons) to twelve or more children. The following must be provided for: Active involvement of children, Differing achievement and ability levels of children, General student planning, Student choices, Student planned inquiry, Use of manipulative materials.

#9. Teach a <u>UNIT</u> (several lessons) of one of the new programs (AAAS, SCIS, ESS) to twelve or more children. Learning activity #3 is a prerequisite.

10. Evaluate two state adopted textbook series at three consecutive levels. All series must be evaluated at the same levels.

11. Propose other learning activities which will help the student to become a better teacher of Science in the elementary school.

* Required

\# If learning activities 8 and/or 9 are completed, the final evaluation will state that you have taught science to a group of children.

The following statement appears at the bottom of the science learning activity sheet. Because of its importance it is in capital letters.

THE ABOVE ACTIVITIES MAY BE AMENDED OR CHANGED COMPLETELY THROUGH STUDENT-INSTRUCTOR AGREEMENT.

In working with the above activities, one must keep in mind that the program must be relevant to the students' needs. Nothing is required in science at any specified time but students signing up for orientation sessions MUST attent. The open laboratory provides opportunity for students to work on any science learning activities. Attendance may vary from 3 to 50. Although students may spend several quarters working in science, most start in their first or second quarter. Activities requiring actual teaching in the public schools are usually not done until the third quarter. In lieu of ABC grades, a higher quality of work is demanded and learning activities are handed back to be done over if they do not meet our approval.

One advantage of CEP is that students can work on areas that are relevant to them when they wish, and postpone those that do not seem to fit at the time. Faculty members are available for help at any time during the two years students are in the program. We feel CEP students are stronger in the science area than students were in previous programs of classes.

SUMMARY

The Childhood Education Program (C.E.P.) at the University of Florida is a humanistic program patterned from The Professional Education of Teachers: A Perceptual View of Teacher Education by Arthur Combs. For the entire time that a student is in the program (usually two years) he meets weekly in a seminar group of 15 students and a seminar leader. He is continuously involved with field experiences in the public schools which increase in time and scope as he progresses through the C.E.P.

The science education component of the C.E.P. is an individually paced program. Students work in science by completing learning activities and may progress as fast or as slow as they wish. To complete their work in science they must complete six learning activities. Four of these are generally required of all students and the other two may be selected from a list or proposed by students. No grades are given, but each learning activity must meet expected standards or it is returned to the student to be done again. Students also must demonstrate science content competence on a standardized test.

Elementary School Science Instruction in Pennsylvania:

Questions and Answers

by

Dr. Irvin T. Edgar
Dr. Carl A. Guerriero
Dr. Joseph Bellucci
Barbara N. Bellucci

The question "What kind of science program do you have in your elementary schools" usually triggers an outbreak of defensive comments from administrators and teachers alike. After explaining what they attempt to do - given their limited resources of time, equipment, and materials - a typical return question they offer is "What are other elementary schools doing in science?" This question is not really asked by elementary school educators to seek information supportive of their own practices, but rather the question generally includes a sincere desire to know more about elementary school science programs. Until recently, only intuitive reactions could be used to give an answer.

Dr. Irvin T. Edgar, Pennsylvania Department of Education
Dr. Carl A. Guerriero, Pennsylvania Department of Education
Dr. Joseph Bellucci, Wilkes College
Barbara N. Bellucci, Consultant

During 1971, the Wilkes College Educational Development Center, with the cooperation of the Pennsylvania Department of Education and the Pennsylvania Science Teachers Association, conducted a statewide survey to determine the status and direction of public elementary school science education in the Commonwealth, primary and intermediate grades. The survey was conducted in three stages and drew heavily from a questionnaire devised by Paul Blackwood for a similar nationwide USOE Study (1965). Details concerning the use of questionnaires, interviews, school visits, and statistical analysis can be obtained from the final report (available from the Wilkes College Educational Development Center) (1.) A portion of that report was presented in a "Questions and Answers" format and should be of direct interest to practicing educators at all levels. The following questions and answers are taken from the report.

Why Teach Science?

The answers of both elementary school teachers and principals to this question were inferred from the way they arranged a list of ten priorities for the teaching of elementary science. A surprising result was that teachers and administrators were in almost perfect agreement as to the way these objectives should be ranked. Stated another way, teachers and principals appear to hold the same purposes for the teaching of science, and they seem to place the highest priority upon developing critical thinking skills, curiosity, and problem-solving abilities among elementary students.

It is interesting to note that teachers and administrators ranked "developing hobbies", "preparing for high school science", and "developing scientists" lowest in importance. This suggests that elementary school educators do not believe they should determine their science teaching values according to secondary school standards or for development of future scientific skills. Instead, general student intellectual skills are expressed as their main concern.

The ten objectives presented in the questionnaire were ranked in the following identical order (hierarchy of importance) by both teachers and principals:

1. Develop critical thinking
2. Develop curiosity
3. Develop problem-solving skills
4. Develop attitudes about environment
5. Develop concepts for interpreting the environment
6. Develop the use of science for the betterment of man
7. Teach knowledge about typical science areas (e.g., plant life, animal life, weather)
8. Develop hobbies
9. Prepare for high school science
10. Develop scientists

What do teachers consider to be the main obstacle to the teaching of science?

The answer to this question is based upon the way teachers ranked a list of thirteen selected factors that described obstacles to the teaching of science. This ranking reveals what teachers consider to be the greatest handicaps in science teaching since these choices are ranked near the top of

the list. Similarly, the factors teachers believe to have relatively little effect in science instruction are ranked nearer the end of the list. The teachers' ranking is shown below:

1. Lack in-service facilities
2. Inadequate room facilities
3. Lack of supplies and equipment
4. Insufficient funds to purchase equipment and supplies
5. Lack of adequate consultants
6. Curriculum not sufficiently determined
7. Insufficient knowledge of science teaching methods
8. Not enough time to teach science
9. Insufficient science knowledge
10. Inability to improvise materials and equipment
11. School believes science less important than other areas
12. Lack of teacher interest
13. Lack of community support

One of the most important and revealing findings of this ranking was the difference between the teachers' ranking of the obstacles and the administrators' ranking of these same obstacles. The discrepancies observed in this comparison of teacher-administrator ranking suggest insight into what may be one of the greatest constraints to the improvement of the teaching of science-disagreement among teachers and administrators concerning obstacles to the teaching of science. It is one thing to agree on the objectives of science teaching (ranking of elementary science teaching priorities) and quite another thing to disagree as to what is preventing students from reaching these objectives. Wherever there is difference of opinion between teachers and administrators on this ranking, conflict can be expected to occur in their dealings over these matters. The administrators' ranking of the obstacles is given below:

1. Insufficient knowledge of science teaching methods
2. Insufficient science knowledge
3. Lack of in-service facilities
4. Lack of adequate consultants
5. Inadequate room facilities
6. Lack of teacher interest
7. Not enough time to teach science
8. Lack of supplies and equipment
9. Curriculum not sufficiently determined
10. Inability to improvise materials and equipment
11. Insufficient funds to purchase equipment and supplies
12. School believes science less important than other areas
13. Lack of community support

It is apparent that administrators focus on inadequately prepared teachers as the main obstacles to elementary school science instruction (insufficient knowledge of science, methods, and lack of interest) while teachers focus upon administrative parameters such as matters of in-service, room facilities, supplies, equipment, and insufficient funds as the major obstacles.

What opportunities do teachers have for in-service science education at schools surveyed?

Over half of the teachers surveyed report opportunities for in-service science education in each of the following areas: teachers' meetings, curriculum development, and workshops. It should be noted, however, that the content, quality, and effectiveness of these workshops were not considered in the survey.

How many teachers surveyed have attended in-service science workshops?

Forty-six percent of the teachers surveyed have attended in-service science education workshops whereas fifty-four percent have not.

The data did not determine the recency nor the nature of the in-service workshop attended by the teacher.

Are teachers generally satisfied with the way they are teaching science?

One-third of the teachers surveyed were satisfied with the way they were teaching science, but two-thirds were dissatisfied. Some of the factors associated with teacher dissatisfaction are: inadequate room facilities, lack of supplies and equipment, lack of adequate consultants, lack of in-service training, and a curriculum that is not sufficiently determined.

Why do some elementary teachers show a lack of interest in teaching science?

Teachers tend to be disinterested in teaching science when the school in general believes science is less important, when there is a lack of time or in-service training, or when the curriculum is not sufficiently determined.

How do educators find out about new science programs?

Over sixty percent of both teachers and administrators indicate that they find out about new science programs through mail brochures. The second most common source of information is the school principal, followed by teacher committees, conventions, the science supervisor, and the department head. This suggests that advertising (along with principals' concepts) has a strong influence in decision making. The difference in teacher-administrator view of the obstacles to science teaching assumes obvious importance at this point.

Is there consultant help in teaching science available within schools?

Forty percent of the teachers have access to consultant help while sixty percent lack the assistance of a consultant. Earlier studies also showed elementary teachers had very little consultant assistance (41.8 percent) even though they said this help was needed. (2)

What approaches to teaching science are being utilized?

Thirty-eight percent of teachers surveyed described their science program as textbook oriented. Thirty-five percent reported using an activity-oriented

program while twenty-two percent used a combination of approaches. Five percent utilized a demonstration-oriented program.

Are textbooks widely used in teaching elementary science?

More than half of the teachers surveyed used one textbook and over one-third used a multi-text approach. About one-eigth used no text at all.

Do textbook-oriented science curricula tend to encourage an activity approach to teaching?

Not according to the survey. Where teachers did indicate that their program was predominantly textbook-oriented, they described their programs as not being activity oriented and generally based on one textbook. Furthermore, they indicated that equipment was lacking.

Where respondents characterized their program as being activity oriented, they typically responded that they did not use a text. They too felt a lack of science supplies and equipment unless their activity oriented program was one of the national science programs in which case the respondents tended to have adequate supplies and facilities.

Teachers trained in a national program also responded that they typically did not use a textbook, nor were they oriented toward a textbook. To what extent are national science curricula (Science-A Process Approach, etc.) used in elementary school districts in Pennsylvania?

Thirty percent of educators surveyed utilize a national science program in their schools. The following percentages indicate the number of administrators surveyed that noted at least one classroom in their school using the following national curricula:

Science--A Process Approach (SAPA) - Nineteen percent

Science Curriculum Improvement Study (SCIS) - Twelve percent

Elementary Science Study (ESS) - Fourteen percent

Minnesota Mathematics and Science Teaching Project (MINNEMAST) - One percent

(N.B. Administrators in some cases indicated more than one program is being used in their school.)

This data should be interpreted carefully since a typical "yes" answer can mean a single classroom or an entire school is using the materials. The degree of a program's usage is always difficult to determine accurately. The best that can be expected is to reveal general trends of usage and to answer large questions such as how widespread or how limited is the use of certain programs. It is safe to say from the above data that national programs are in use in Pennsylvania schools, but to a limited degree. They are certainly not widely used at the present time even though they have been available over the last ten years or so.

Are teachers receiving training in the use of national curricula?

Among all schools in the survey the percent of teachers trained in national curricula through in-service was 24.4 percent, summer institutes - 15 percent, consultants - 14.4 percent, or by some other means - 10 percent. These figures indicate the training of the teachers in national programs through the above activities regardless of whether or not those teachers are using the programs in their classroom.

Where teachers are using a national program in their classroom, it seems they generally received training in a national program. A significant and positive correlation was found (r= .647) between the use of a national curriculum in a school and teachers in the school having been trained in national programs.

Do classes participate in science fairs and exhibits?

One one-fifth of teachers queried reported class participation in science fairs or exhibits.

Do students go on science-oriented field trips?

Over half (51 percent) of the teachers surveyed report that their classes have taken a science-oriented field trip.

Is science taught as a part of the teacher's regular teaching duties?

Seventy-eight percent of teachers surveyed teach science as a part of their regular teaching duties while twenty-two percent are special science teachers. The vast majority of elementary teachers teach science and other subjects.

Where departmentalization does occur in the primary grades, it is very limited - in grades one (2.3 percent), two (2.5 percent), and three (4.8 percent). There is an increase of departmentalization to over 20 percent (22.5 percent) in grade four, which increases to 38.1 percent and 39.8 percent for grades five and six, respectively. Generally, science is taught in non-departmentalized classrooms for the majority of elementary students at all grade levels. Departmentalization, when it occurs, is usually found in the intermediate elementary school grades.

In what grades do children go to a special room for science?

Until they are in fourth grade, only a very small percentage (less than 3 percent) of students in the schools surveyed go to a special room for science. Fourteen percent of fourth grade students and one-quarter of fifth and sixth graders have science in a special room. For the most part, students studying science in a special room may be expected to study science in a departmentalized setting. This cannot be determined by the data, however.

How large is the average class in elementary science?

There are 27 students in the average elementary science class. The number ranges between 23 and 31. Generally, the size of a science class is the same as any other subject class size.

How much time is spent per week on the teaching of science?

The time per week described as allotted to science ranges from 30 to 300 minutes. The average time per week is 166 minutes according to the survey. The amount of time spent teaching science in the primary grades is generally less than the time spent teaching science in the intermediate grades. This difference is neither apparent nor documented by the data although it was discussed during on-site visits by the survey staff.

To what extent are equipment and supplies for science demonstrations and experiments available?

Teachers surveyed report equipment and supplies for science demonstrations and experiments in their schools as being:

Plentiful -	12 percent
Adequate -	55 percent
Inadequate -	27 percent
Lacking -	6 percent

Thus, twelve percent of the teachers describe their equipment and supplies as plentiful while thirty-three percent of the teachers say they have insufficient equipment and supplies.

These figures are general and for all teachers surveyed. An examination of the relationship between the program used by the teacher and the availability of equipment and supplies provides additional insight. For example, teachers using national programs in elementary science felt that equipment and supplies were available and that they did have adequate room facilities, supplies, equipment and funds. On the other hand, teachers describing their program as predominantly textbook oriented or non activity oriented felt they lacked supplies and equipment.

Who orders science equipment?

The majority of teachers order their own equipment. Next likely to be responsible for ordering equipment is the principal, followed by a teacher committee or the elementary supervisor. Least likely to order science equipment is a department chairman or the science supervisor.

It is interesting to note that although teachers are mainly responsible for ordering their own science equipment, only 12 percent of all teachers consider their science equipment plentiful. The rest rate their equipment somewhere between adequate and lacking. Either teachers do not order science equipment or their requests for equipment are turned down. On-site visits frequently lend support to the former explanation.

How are science textbooks or materials adopted?

In most schools (82.5 percent), science textbooks and materials are adopted by a teachers' committee. The school principal, central office, or others adopt materials and books in schools where this is not a function of a teachers' committee.

A logical conclusion to draw from this data is that the present state of elementary school science teaching is a direct choice of teachers - both the science curricula and the related materials. The data, however, do not explain whether teachers' committees are given total control over their choice of materials or whether they follow the guidance and direction of the administrative staff in the schools. The answer may lie somewhere between these two positions.

Nevertheless, teachers presently have the potential for a majority voice in establishing priorities for the adoption of science curricula and supplies.

To what extent are science materials centers available?

Over three-quarters of all educators surveyed have a science materials center in their district. However, the science materials center referred to may be anything from a supply closet to a well-equipped materials center serving the entire district.

Do schools present alternative choices to a traditional grading system?

Ten percent of Pennsylvania schools do not give children a regular grade in science. Schools with national science curricula tend not to use traditional grading procedures whereas schools using a single text approach do tend to give science grades.

It is interesting to note that the survey results support many intuitive reactions of science educators regarding elementary school science both in Pennsylvania and nationally. Nevertheless, recommendations should be made only from data which are supportable and generalizable. The major recommendations in the report are the most important outgrowth of it and should serve as a focal point for mutual teacher-administrator interaction in improvement of elementary school science instruction.

---

1. Bellucci, Joseph and Barbara, Edger, Irvin T., and Guerriero, Carl A. Science Teaching in Pennsylvania Public Elementary Schools. Wilkes College Educational Development Center, Wilkes-Barre, 1973.

2. Blackwood, Paul E. Science Teaching in the Elementary Schools. Office of Education (OE - 29059), U. S. Department of Health, Education and Welfare, U. S. Government Printing Office, Washington, D.C. 1965.

3. Edger, Irvin T. (ed.) "Science for the Seventies Pennsylvania's Guide for Elementary Science", The Pennsylvania Department of Education, Harrisburg, 1970.

Author Manuscript Submission Form

DEADLINE FOR SUBMISSION OF ARTICLES ..... January 31

ARTICLE LENGTH.....up to 4 pages, 8½ x 11, single-space, with a one paragraph summary at the end identified with the heading-SUMMARY, centered. Copy this information.

PHOTOGRAPHS .....black and white only

DRAWINGS .....submitted on white cardboard and rendered ready for camera work -- only in India Ink

I plan to submit a science education manuscript on the elementary level on or about (date) _____

The title will be "_____

_____

_____"

My Name _____

Address (home) _____

City _____ State_____ Zip_____

College Affiliation _____

Department _____ Your Rank_____

Phone _____ Best time to call _____

College Address _____

City _____ State_____ Zip_____

Make a copy of your manuscript before submitting.

Send all manuscripts in a large envelope in which the manuscript pages and/or drawings and/or photographs are protected by at least one piece of cardboard. All drawings and photographs as well as the original manuscript will not be returned. Additional copies of The Clearinghouse, as long as the supply lasts, will be $1.00, check in advance, payable to THE BLOOMSBURG STATE COLLEGE TRUST FUND # 477T and sent to the Editor.

Send manuscript to:

Dr. Donald A. Vannan, Editor
The Clearinghouse
Bloomsburg State College
Bloomsburg, Pennsylvania 17815

-cut here-